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Revisions to Method 3, Appendix A of 40 CFR Part 60 (Proposed September 7, 1982, 47 FR 39204): Summary of Comments and Responses

(U.S.) Environmental Protection Agency
Research Triangle Park, NC

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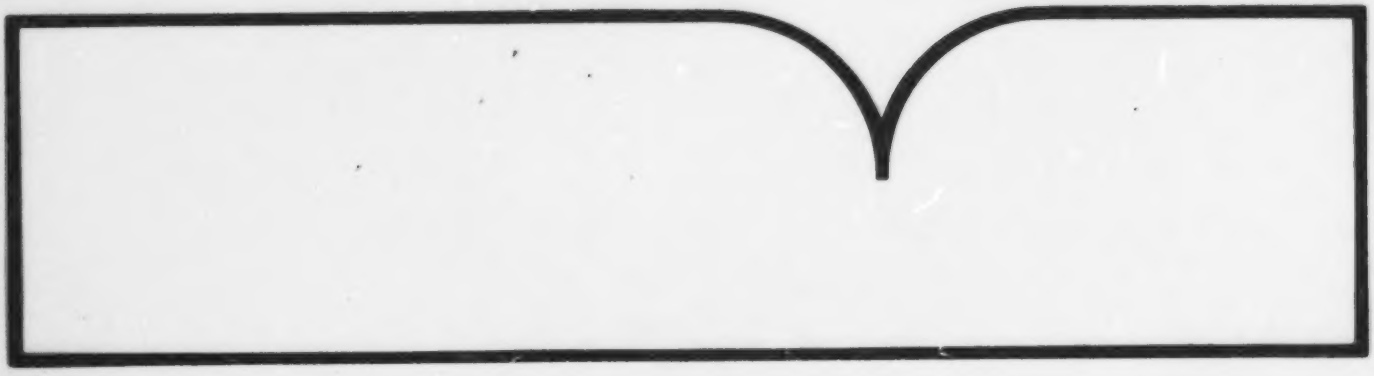

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This document addresses the public comments submitted after proposal of the revisions to Method 3 in the Federal Register. Changes made as the result of these comments are included. This document serves as a basis for the changes made in the revisions to Method 3 between proposal and promulgation.

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Revisions to Method 3, Appendix A of 40 CFR Part 60 - (Proposed September 7, 1982, 47 FR 39204) Summary of Comments and Responses

Emission Measurement Branch
Emission Standards and Engineering Division

U.S. ENVIROMENTAL PROTECTION AGENCY
Office of Air, Noise, and Radiation
Office of Air Quality Planning and Standards
Research Triangle Park, North Carolina 27711

November 1983

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Chapter 1

Introduction

On September 7, 1982, the U.S. Environmental Protection Agency (EPA) published in the Federal Register (47 FR 39204) "Revisions to Method 3, Aprendix A of 40 CFR Part 60." These revisions were proposed under authority of Sections 111, 114, and 301(a) of the Clean Air Act as amended.

Public comments were solicited at the time of proposal. To provide interested persons the opportunity for oral presentation of data, views, or arguments concerning the proposed revisions, a public hearing was scheduled for November 8, 1982. The hearing, however, was not held because no one requested to speak. The public comment period was from September 7, 1982, to November 8, 1982.

Seventeen comment letters on the proposed revisions were received from industry, State air pollution control agencies, trade associations, and testing consultants. The comments that were submitted, along with EPA's responses, are summarized in this document. The summary of comments and responses serves as a basis for the revisions that have been made to the test methods between proposal and promulgation.

Chapter 2

Summary of Changes Since Proposal

1. The F_O check is made an optional procedure instead of a mandatory one.

2. Sections 4.1.5 and 4.2.7. These paragraphs are revised to replace the words "Citation 5 in the Bibliography" with "Section 4.4" so that the quality control procedures are identified specifically.

3. Section 4.4. The heading is changed to "Quality Control Procedures" to indicate the optional nature of the procedures.

4. Section 4.4.1. Changes are made to this section to explain the use and applicability of the F_O method.

5. Sections 4.4.1.1 and 4.4.1.2. These paragraphs are added to explain the F_O calculation procedures and to account for high CO concentrations and for mixed fuels.

6. Section 4.4.1. The table of F_O values is changed to a range of values for each fuel type and is used in place of the ± 5 percent acce tance limit in the proposed revisions.

7. The requirement for an ambient air check of the Orsat is deleted.

8. Method 19, Table 19.1. The value for F_C for wood bark is corrected.

9. Method 19, Section 5.2.2. The equations for fuel factors are corrected.

Chapter 3

SUMMARY OF COMMENTS AND RESPONSES

Commenter IV-D-1

1.1 Comment: Sections 4.1.5 and 4.2.7. The proposed change from running analyses for either CO_2 or O_2 to running analyses for both CO_2 and O_2 is acceptable as this is the procedure the company has been following.

Response: No response is necessary.

1.2 Comment: Section 4.4.1. Data validation or verifying that the fuel factor is ± 5 of the established value is primarily a check on the chemicals in the Orsat analyzer used in determining the CO_2 concentration, and can be readily incorporated into company procedures.

Response: No response is necessary.

1.3 Comment: Section 4.4.2. Checking Orsat chemicals for detecting O_2 by analyzing ambient air is a standard procedure before each use. The proposed requirement to add a post check is a good quality assurance (QA) check which can be easily implemented.

Response: No response is necessary.

1.4 Comment: Section 4.4.3. The reference to "above criterion" should be replaced with a specific reference citing the appropriate section or sections. Clarification is also needed as to what "sampling and analysis and quality assurance check" is to be repeated when criterion is not met. It is unclear whether this section applies to just the test of the gas sampling or the complete run.

Response: The criterion of ±5 percent is increased and is replaced with a table of acceptable F_o ranges for each fuel type. The promulgated version of the revisions does not contain a requirement for retesting if the check limits are not met, but recommends that the problem be investigated and suggests some typical areas for investigation.

Commenter IV-D-2

2.1 Comment: When the Orsat apparatus is used to determine the gas composition, it is typical to analyze the gas for oxygen, carbon dioxide, and carbon monoxide in order to provide data for the molecular weight of the gas, emission rate correction factor or the excess air ratio. Thus, no additional effort is required by this revision. The calculation of the F_o-factor is easily done with the Orsat results.

Response: No response is necessary.

2.2 Comment: The analysis of a sample of ambient air after the analysis of the source gas sample will add 15 to 30 minutes to the compliance test, but will provide credibility to the data. If the proper air composition data are obtained, it will show that the absorbing solutions are not exhausted. Without this ambient air sample, the results of the final runs of source gas are assumed correct. This has been inferred in the past, if the three analysis runs on each sample of source gas gives essentially identical results. As the absorber solutions become depleted, they will absorb less gas and the results on the individual components would decrease on each run.

Response: It is not necessarily true that partially depleted absorbing solutions will lead to lower or incorrect measurement of gas component concentrations, but more passes will be necessary to achieve complete absorption. Analysis is easier and, thus, more likely to be accurate with fresh absorbing solutions.

Commenter IV-D-3

3.1 Comment: Calculating the F_o factor seems worthwhile. However, it would be more convenient to state the acceptable range of F_o values for a given fuel rather than state, ". . . $\pm$5" (I assume percent) "of the established value. . ."

Response: An F_o table is included in the promulgation version that lists the acceptable range for each F_o factor. The ranges are generally greater than $\pm$5 percent and are more representative of actual ranges experienced in field tests.

3.2 Comment: The F_o procedure here does not provide for those cases where multiple fuels are burned. It is not at all unusual to see boilers at furniture factories in North Carolina which burn wood and oil simultaneously.

Response: The calculation of the F_o factor for mixed fuels is included in the final procedure.

3.3 Comment: Performing an Orsat measurement on ambient air appears to be a waste of time, effort, and Orsat O_2 reagent. It proves nothing about the accuracy of results for stack gas. In the case where the O_2 reagent becomes exhausted during the performance on air, it has not shown that it was exhausted previously. I think that the requirement for three repetitions of the Orsat method on a given

gas sample gives about as good proof as you are going to get that the method is performed correctly and that the Orsat reagents are sufficiently active.

Response: The purpose of the analysis of the air sample is to check the equipment, the analyzer, and the technique to measure accurately a known concentration. The chemical strength of the absorbing solution is checked in another section of the method (Section 4.2.5). The Agency agrees that obtaining an accurate measurement of O_2 for an air sample does not assure that measurements in other ranges or of other components are accurate; however, an inaccurate measurement of the O_2 concentration in air is an indication of a serious problem in the equipment or the technique that should be investigated before accepting the results.

3.4 Comment: While you are out to change things, why not say something about O_2 meters (fuel cell or paramagnetic detector types)?

Response: The scope of these revisions does not include O_2 meters.

3.5 Comment: Aside from good Orsat technique, the most important thing for accurate results is a leak free sampling setup. A leak check from probe tip to sample bag before and after sampling seems worthwhile.

Response: In Method 3, Sections 4.1.2, 4.1.5, 4.2.2, and 4.2.7 describe mandatory leak-check procedures for sampling equipment. Section 5 describes the leak-check procedure for Orsat analyzer equipment. No additional leak-check procedures are required.

Commenter IV-D-4

4.1 Comment: The proposed revisions to Method 3 contained in Appendix A of 40 CFR Part 60, are questionable as to their quality assurance benefit. Method 3 presently requires that an individual analysis not differ by more than 0.3 lb/lb-mole from the mean of the required minimum of three analyses. While the procedure does not necessarily document the accuracy of the results, it does document the precision of the analysis.

Response: The precision check of the molecular weight determination is not part of these revisions. In addition, the molecular weight check is really insensitive to Orsat errors and does little to indicate the accuracy of the O_2 or CO_2 measurements.

4.2 Comment: My interpretation of the intent of the proposed revisions is to certify the absorbing reagents are not depleted during the analysis by a comparison to ambient air. Any depletion of an absorbing reagent should be obvious when comparing the results to the prior analysis and become even more obvious with the next analysis. There is also the chance the absorbing solution may become depleted on the ambient air analysis, thus making the stack gas analysis results questionable. If a procedure change must be made to ensure the accuracy of the results, it would require an ambient air analysis prior to the stack gas analysis and an ambient air analysis after the stack gas analysis to bracket the data. This procedure would only serve to enhance the chance of absorbing reagent depletion during the stack gas analyses or the final ambient analysis. The presently required quality assurance procedure seems adequate.

Response: See Response 3.3.

4.3 Comment: The use of a fuel factor, F_o, for verification of $\pm$5 percent of the established value is also questionable. The fuel factor does not allow for combinations of fuels.

Responses: See Response 3.2.

4.4 Comment: The F_o values can vary with the ultimate analysis of the fuel. Does the $\pm$5 percent tolerance allow for experimental error such that the summation of the experimental error and the expected variance in the F_o for a particular fuel type does not exceed 5 percent? EPA publication EPA 450/2-79-006 reports maximum deviations (percent) from the midpoint F_o factors for bituminous coal and oil as being 4.5 percent and 4.1 percent, respectively.

Response: See Response 3.1.

4.5 Comment: An inspection of the fuel factor formula indicates a conservative bias in respect to the percent excess air used in a facility. A 0.1 percent difference by volume in the analysis of either CO_2 or O_2 generates a greater deviation from the "established F_o value" with an increase in excess air. It is obvious that the greater the excess air, the more the probability the resultant calculated F_o will exceed the $\pm$5 percent. It is not uncommon for wood-fired boilers to use 500 percent excess air. A $\pm$0.3 percent difference by volume in analysis would generate a $\pm$5 percent difference in F_o. Orsat analysis required accuracy is $\pm$0.3 percent difference by volume.

Response: See Response 3.1. In addition, this comment shows the need for greater assurance of Orsat accuracy at higher excess air conditions in order to obtain accurate measurement of emission rates.

4.6 Comment: It is thought the proposed revisions would not enhance the presently established quality assurance procedures and should not be incorporated into Method 3.

Response: The Agency disagrees with this comment that the F_o calculation is not a good indicator of the accuracy of Orsat measurements. However, there are several difficulties in the application of the F_o procedure as a requirement that have led the Agency to revise the proposed required calculation to a recommended procedure in the promulgated version. These difficulties include: (1) problems with sources determining a suitable F_o value for mixed fuels because the ratio of fuel combustion rates is not always easily or accurately determined; (2) suitable F_o values are not readily available for all fuels such as vegetable wastes or organic chemical wastes; (3) the F_o procedure would not apply to all tests with the Orsat, only to those on sources burning organic fuels, making the requirement unequally applied; and (4) rejection of a test run or set of runs because of an errant F_o check is severe in many cases as the solution to the problem can be found without retesting.

Commenter IV-D-5

5.1 Comment: Better clarification is needed to indicate that the revision only applies when determining emission correction factors or excess air for combustion sources. The supplemental information section states that these revisions would apply to all sources subject to standards of performance specifying the use of Method 3 for O_2 and CO_2.

Response: These revisions are located only in Section 4 of the method which applies to excess air correction and emission rate calculations.

5.2 Comment: Section 4.4.1 states that one must "verify that the fuel factor, F_o, is within ± 5 of the established value . . . ." This appears to be a large variation, considering the range of values suggested in the published table, and we suspect a typographical error was made in this "± 5" value. If this is an error, two likely possibilities exist, "± 5" or "± 5 percent". If the Agency intended a 5 percent variation limit for the F_o factor, then this range is too restrictive. Absolute errors of only 0.2 percent in values of both the O_2 and CO_2 readings can result in a 5 percent variation in the fuel factor, F_o.

Response: See Response 3.1.

5.3 Comment: It is very easy to exceed ± 0.2 percent using the Orsat analyzer. We suggest reviewing EPA's June 1982 quality assurance audit for Orsat analysis of O_2 and CO_2. According to this audit, less than 20 percent of the participants could expect to meet the 5 percent limit based on accurate O_2 and CO_2 measurements. Only with off-setting inaccuracies in the O_2 and CO_2 determinations (one high and one low) could more than 20 percent of the participants expect to meet the 5 percent limit.

Meeting this limit by compensating errors will not assure good quality data. On the contrary, it will provide a false sense of security

that the data is reliable, when in fact it will be in error to the extent of the error made in the O_2 or CO_2 gas concentration measurement.

Response: The Agency feels that the F_o factor calculation is an important indicator of just the problem the commenter mentions. Inaccurate measurement of O_2 or CO_2 concentration will be indicated by the F_o calculation. Other problems, such as leaks, are addressed in other sections of the method. The Agency reviewed the audit results mentioned by the commenter and determined most of the problems encountered in obtaining accurate analyses were a result of leaks. This indicates more of a problem with obtaining a representative audit sample rather than an inherent analysis or field testing problem.

5.4 Comment: The revision should recognize and emphasize the fact that some sources will not have the same F_o factors that are calculated from the fuel type. For example, the F_o factor on a glass melting furnace firing gas is on the order of 1.3, not 1.75. This much lower value results from large volumes of CO_2 liberated from the glass batch during melting. Batch composition changes will result in variable F_o factors.

Response: The intent of the revision was not to cover all industry sources, but to apply where excess air or emission rate correction calculations are required. We agree glass manufacturing is an example of a source for which the F_o factor is not applicable.

5.5 Comment: A simplified technique should be utilized to estimate a comparative F_o value when a mixture of fuels is utilized, e.g., oil and gas.

Response: See Response 3.2

Commenter IV-D-6

6.1 Comment: I agree with these proposed revisions and consider them to be necessary parts of professional sampling procedure.

Response: No response is necessary.

6.2 Comment: However, the other proposed revision--assuring that the gas analysis results agree with the limits specified for the fuel, using the F_o factor procedure--cannot be unilaterally applied to all industries regulated by 40 CFR Part 60. According to the proposed revision, the F_o factor for Portland cement plants, using a bituminous coal fuel source, should be 1.140. Method 3 gas analysis data of our wet process Portland cement plants' stack gases, indicate an average F_o of about 0.70. The disparity in the F_o factors arises from the assumption that all CO_2 in the stack gas is generated from fuel combustion. In Portland cement production, CO_2 is generated from the raw materials. In the calcination process of cement production, calcium carbonate (limestone) is converted to calcium oxide (lime) and carbon dioxide. While we would expect CO_2 concentrations of 12.5 percent to 13 percent from the fuel combustion, we experience CO_2 concentrations of approximately 20 percent to 21 percent from the fuel combustion and the calcination process. The F_o factor is only meaningful for industries which do not, during their production processes, affect the CO_2:O_2 ratio.

Response: This is true and the revisions note for which industries the checks can be applied. The promulgation version will contain more explanation about applicability. See Response 5.4.

Commenter IV-D-7

7.1 Comment: The authors are not clear as to the specific objectives for modifying the QA procedures for Methods 3, 4 and 5. Confusion is furthered by not addressing the problems associated with the proposed methods, and more important, not addressing why current QA procedures are not fully enforced.

Response: The promulgation version addresses the issues with the proposed revisions raised by the commenters. Addressing the reason current QA procedures are not enforced, is not within the scope of this revision.

7.2 Comment: EPA suggested, but not mandatory, QA handbook and QA source survey are not mentioned at all.

Response: The intent of these revisions is to include quality control procedures not already included in the method that would enhance data quality. The references mentioned by the commenter are available from other sources.

7.3 Comment: Stating that "little additional effort is required" is entirely subjective and dependent on a large number of factors. Potentially, great effort could be required to satisfy these proposed requirements, when equivalent alternatives are available.

Response: If the measured quality control checks do not fall within the specified limits, there is indication of some serious error in the sampling or analysis. Time should be given to finding the source of the error and resolving the data. The promulgation version makes the revisions optional, thus, the time required to perform or

not perform the procedures is left to the tester; however, the quality control checks are recommended as being beneficial to the tester.

7.4 Comment: Using an F factor as a comparison tool exposes one to all the inherent problems and complications. As Roger Shigehara, et al, observed in "Validating Orsat Analysis Data from Fossil-Fuel-Fired Units," the method does not apply to sources that remove CO_2 (such as wet scrubbers) or O_2, add O_2 and N_2 in proportions different from air, or add CO_2. The likely potential of incomplete combustion and its resulting CO are not addressed.

Response: The promuglation version clarifies the applicability of the procedures and discusses the variations of equations to accommodate alternate fuels, incomplete combustion, and mixed fuels.

7.5 Comment: When testing sources utilizing fuels with unpublished F factors, the Orsat data apparently must be validated (or invalidated) upon completion of the fuel analysis - long after the test program is completed. When using an F factor based on fuel sample analysis, the Orsat data will be compared to data (fuel analysis) with possibly less quality assurance than its own, effectively defeating the purpose. When sampling for Method 3 is simultaneous with other emission parameters, are all parameters to be resampled if the Orsat data are invalidated? Air leakage in the system, inevitable to some degree, could invalidate the test program even though their sampling and analysis were entirely valid. Unlike isokinetic calculations, there is no acceptance criteria for calculated adjustments (bias against the source).

Response: The revised procedures are intended to be used on-site at the time of the test or in order to verify the quality of the Orsat data. It is not the intent to require the tester to perform a fuel analysis in order to complete the quality control check. See also Response 3.1.

7.6 Comment: An alternative QA method is the use of standardized composite gases in portable pressure cylinders. These cylinders, already used for the EPA QA source audit survey, have the capability of being used in the laboratory or field, pre- or post-test. In addition, they can be used for molecular weight determination quality assurance, along with sources with unpublished or "complicated" F factors. In each case, analytical verification is immediate, enabling the sampler to verify or void the data on site.

Response: QA cylinders are an acceptable option; although, use of cylinders requires an extra sampling and analysis test which is avoided by the F_o factor calculations. In addition, leaky sample lines from audit cylinders would result in unacceptable analysis results while, in fact, test results may be acceptable. See also Responses 4.1 and 5.4.

Commenter IV-D-8

8.1 Comment: Revision to Method 3 should be delayed to allow more time to evaluate how adequate the EPA F_o factors are for fuels. Specifically, combination fuels including a solid fuel should be exempted.

Response: F_o factors for mixed fuels can be calculated with a good degree of tolerance. Fuel ratios accurate to within ± 25 percent

can be used to determine an expected F_0 factor that still allows reasonable ($\pm$5 percent) measurement imprecision in meeting the quality control check. A procedure for establishing an expected F_0 factor for mixed fuels is included in the promulgated revisions. There remains some problems within industry in accurate measurement in fuel combustion rates and in determination of suitable F factors for unusual fuels, such as vegetable wastes and wood materials, that make determination of the fuel ratio-based F_0 factor to within even $\pm$25 percent a difficult task. This issue is discussed in the applicability section of the revisions.

Commenter IV-D-9

9.1 Comment: Coal, gas, liquid and sometimes lignite fuels can achieve the $\pm$5 percent of the established values, but only if a wet scrubber is not involved. When a wet scrubber is used on a source as a control device, the Orsat results are normally $\pm$6 to $\pm$10 percent from the established values.

Response: The results included by this commenter reflect a lower than expected CO_2 concentration. (Calculated F_0 values are greater than theoretical.) This is a possible situation if CO_2 is actually removed by the scrubber liquor. Dissolution of CO_2 in aqueous solutions used in most power plant SO_2 scrubbers is inhibited by the acidic condition of the slurry and probably does not occur in significant quantities. The data supplied by the commenter show that only 3 of the 12 tests on scrubbed exhaust gases result in F_0 values

outside of the ranges listed in the table in the revisions. For each of the three results, there is a duplicate test result that falls within the recommended limits. This indicates that some CO_2 dissolution may have occurred, but the emission rate results should not be significantly affected. Scrubbers which use aqueous solutions that are not acidic, such as water or basic slurries, can dissolve some CO_2 thus affecting the results. Test results from such scrubbers should be reviewed with this possibility considered.

9.2 Comment: When a combination of fuels are used, such as oil and bark, the comparison to the established values is inappropriate because generally the amount of each type of fuel burned is not known until well after the field testing is completed. Also, there are significant variations in the barks and woods burned.

Response: See Response 8.1.

9.3 Comment: In plants that the process produces or consumes carbon dioxide or oxygen, such as lead smelters, lime kilns, sulfur recovery units, and cement kilns, no valid comparison can be made to the established values.

Response: Except for sulfur recovery plants in this list of industries, the F_o factor quality control check would not apply as Orsat measurements are not necessary. For sulfur recovery units (kraft pulp mills, refineries, etc.) the F_o factor check is not easily applied because of CO_2 evolution.

9.4 Comment: Many fuels, such as lignite, vary widely in quality and burning characteristics. Although it is allowed to determine F_o from ultimate analysis of the fuel, these fuel samples taken during

the testing cannot be analyzed until well after the completion of the field tests. This makes it difficult to repeat the Orsat analysis.

Response: See Response 7.5.

9.5 Comment: Ambient air should always be run in the Orsat analyzer before using, and the criterion set in this section is good. However, I have taken Orsat samples on plants at altitudes of over 8000 feet and some allowances may have to be made for high altitude samples.

Response: The Agency is not aware of a significant problem with high altitude measurements.

9.6 Comment: To arbitrarily reject Orsat samples on the basis of the two criteria specified actually borders on the ridiculous. It would certainly be a utopian world if all fuels and processes performed to within ± 5 percent of a specified number. Unfortunately, my 10 years of sampling sources has provided a much different perspective.

Response: See Responses 4.6.

9.7 Comment: Based on the analyses of over 150 individual source samples on fossil fuel-fired steam generators, it seems that a much better criterion for validating or invalidating Orsat samples is to put them in the perspective in which they are used, which is to calculate the emission rate from a source. For several years now, we have calculated the emission rate from such sources by three different methods: using the F factor, using the F_c factor and using process heat input data. The first method utilizes the oxygen content from the Orsat analysis, the second method utilizes the carbon dioxide content from the Orsat analysis, and the third method does not utilize

either of the analyses. By comparing the emission rate calculations from these three methods, errors in Orsat analyses can be readily detected. However, if the source is well in or well out of compliance with the applicable standard, any error in the Orsat analyses may be insignificant.

Attached to these comments are several examples of where the Orsat analysis does not meet the criterion set forth in Section 4.4.1, yet the calculated emission rates are very close and do not affect the determination of compliance and noncompliance. The presented data are typical and not intended to be all inclusive. More data are available, if desired.

Therefore, possibly a more useable and representative criterion would be to evaluate the emission rate calculations and to establish a criterion that the calculated emissions using the F factor and the F_c factor should be within $\pm$20 percent of each other. This would consider the impact of the Orsat analysis in all the calculations.

As an alternate, since the $\pm$5 percent appears to be too restrictive for all sources, the data suggest a criterion of $\pm$10 percent would cover virtually all types of sources and fuels.

Response: The Agency agrees that the level of emissions in relation to the compliance level should be considered in determining acceptance because of poor Orsat data. Also, the use of F factor and F_c factor comparisons is very similar to F_o checks resulting in similar comparisons. See also Response 3.1.

Commenter IV-D-10

10.1 Comment: The F_o is a valid quality assurance factor for for judging the accuracy of a gas composition analysis provided that the combustion/gas stream under test does not include a generator or an absorber of carbon dioxide between the combustor and the point of measurement. Examples of such includes kilns that add CO_2 and wet scrubbers that remove CO_2. If CO_2 is added or removed from the combustion gas prior to sample gas collection, the F_o of the gas analysis will deviate from the value characteristic for the given fuel type.

Response: See Response 9.1.

10.2 Comment: The F_o is not a valid quality assurance factor if it is calculated using the equation that has appeared in most publications, when the combustion process under test is incomplete and considerable concentrations of methane and carbon monoxide exist. Equations to calculate F_o should be revised to account for these conditions and the proposed regulation amended to alert the user which source types justify the additional effort required to analyze for these products of incomplete combustion.

Response: See Response 7.4.

10.3 Comment: The F_o only elucidates errors in Orsat analyses that result from independently derived biases in the analysis of CO_2 or O_2. The F_o factor does not reflect errors caused by dilution of the

collected sample with air during or after sample collection. Thus, a leaky bag may cause significant error in the Orsat analysis even though the F_o obtained for the analysis agrees well with the published value.

Response: This is true. There are other quality control and quality assurance checks within the method which address leak problems.

10.4 Comment: The use of ambient air as a calibration gas has value and has been used in our laboratory for years. However, only rarely does the oxygen content approach 20.9 percent in combustion samples. Moreover, the use of ambient air as a calibration gas provides no check on the CO_2 in nitrogen standard gas with very good success. The sample is taken from the cylinder into an evacuated bag and then drawn into the Orsat analyzer buret. This standard is stable and lasts about 2 years when careful withdrawal techniques are employed.

Response: See Response 7.6.

10.5 Comment: The volumetric absorption procedure referred to as an Orsat analysis is an old and time-consuming procedure which if properly performed by an experienced technician gives accurate results. The tedious nature of the analysis, however, renders shortcuts attractive to the busy analyst. Our laboratory has routinely performed gas composition analyses on noncompliance tests by gas chromatography with a thermal conductivity detector and a dual loop

gas sampling valve. We have performed numerous comparisons between the Orsat, GC and electrochemical results (Teledyne Model 320P oxygen analyzer at room temperature in the lab with the gas samples temperature equilibrated for several hours) and found excellent agreement between all three methods. For this reason, we strongly recommend that GC/TCD be allowed as an alternate to the Orsat method with the same sample quality assurance criteria. The 2.5 minute analysis time for CO_2, O_2, and N_2 and 3.5 minutes for CO_2, O_2, N_2, CH_4 and CO allows the analyst to repeat an analysis several times, if he has any doubts about its validity and can provide data on methane and carbon monoxide, the existence of which are often overlooked (wood-fired boilers, cupolas, etc.) by inexperienced personnel.

Response: Alternative instrument procedures are not within the scope of these revisions.

Commenter IV-D-11

11.1 Comment: In Section 4.4.1, delete the sentence: "Using the following procedure, verify that the fuel factor, F_o, is within ± 5 of the established value (i.e., either the average value found in the table below or the value calculated from the ultimate analyses results of representative fuel samples following the procedures in 40 CFR Part 60, Appendix A, Method 19)." Replace it with: "Using the following procedure, determine whether the fuel factor, F_o, lies within the established ranges (i.e., either the average value found in

the table below or the value calculated from the ultimate analyses results of representrative fuel samples following the procedures in 40 CFR Part 60, Appendix A, Method 19)."

Delete the F_o factor table. Replace it with:

Fuel type	F_o range
Coal:	
Anthracite and Lignite.	1.016 - 1.130
Bituminous.	1.083 - 1.230
Oil:	
Distillate.	1.260 - 1.413
Residual.	1.210 - 1.370
Gas:	
Natural	1.600 - 1.836
Propane	1.434 - 1.586
Butane.	1.405 - 1.553
Wood	0.997 - 1.120
Wood bark.	1.003 - 1.130

Response: Using ranges instead of percentages is a practical approach that the Agency has adopted in the final package. The ranges stated in the comment were revised slightly before the final table was prepared.

11.2 Comment: In Section 4.4.2, delete the sentence: "At the completion of each test series (e.g., set of three test runs), analyze a sample of the ambient air with the Orsat." Replace it with: "When the calculated F_o does not lie within the specified range or when the fuel does not have a specified F_o value, analyze a sample of the ambient air with the Orsat."

Response: This is a good suggestion, and it is included in the promulgated version of the revisions as a suggestion.

11.3 Comment: In Section 4.4.3, delete the sentence: "If either of the above criteria is not met, repeat the sampling and analysis and the quality assurance check." Replace it with: "If the calculated F_o does not lie within the specified range and the O_2 value of the ambient air analysis is not 20.9 $\pm$ 0.3 percent, repair the Orsat and reanalyze the sample. If the calculated F_o still does not lie within the specified range and the O_2 value of the ambient air analysis is not 20.9 $\pm$ 0.3 percent, repeat the sampling and analysis and the quality assurance check."

Response: This is a good check for an integrated bag sample, but would not be appropriate for a grab sample. Resampling for a grab sample is necessary. In any case, such procedures will be left to the discretion of the tester and not be required in the method.

11.4 Comment: Our comments, if adopted, also would assure that "the quality of compliance data will improve," the stated objective of the proposed revisions. In addition, by only requiring F_o to fall within the specified range for validation of the measured CO_2 and O_2, additional field time and expense required for the ambient air analysis would be eliminated. Further, the analyses of ambient air where the O_2 value is not 20.9 $\pm$ 0.3 percent do not necessarily invalidate the results of previous flue gas analyses. Since the analysis of one ambient gas sample is the equivalent of 2 to 5 typical flue gas analyses, the O_2 absorbent may deplete before completing the ambient air analyses. However, the Orsat analyzer may have been working properly during previous flue gas analyses (as validated by the F_o value check). Also, failure of the ambient air analysis to fall within

the specified range simply indicates that a problem with the Orsat exists. Previously analyzed flue gas samples whose F_0 did not fall within the specified F_0 range should be reanalyzed after repairing the Orsat or using another Orsat.

Since the F_0 values presented in the proposed revisions are based on the carbon-to-hydrogen ratio of each fuel type and the stoichiometry of combustion, $\pm$5 percent of these proposed values may not represent the ranges actually measured for each fuel. We feel our proposed ranges of F_0 values better represent the range for each fuel type typically encountered in stack testing. After the direct involvement of Entropy personnel in the original development of F factor and F_0 values, we have used the relationship between CO_2 and O_2 percentages versus fuel type as internal checks for all our Orsat data collected at combustion sources. Our proposed ranges are based on our internal check of 1,000 - 2,000 Method 3 test runs per year for the last 5 years.

Section 4.4.3 as published in the proposed revision does not assure the quality of compliance data; rather, it has more potential to require additional sampling and analyses by the tester due to factors beyond the tester's control. If the F_0 value lies outside the specified range but the analytical criteria as set forth in Method 3 are met and the ambient air check is valid, then the data must be accepted as accurate. In such cases, the tester's only responsibility should be the notation in the test report of F_0 values outside the specified range. F_0 values can fall outside the specified range due to numerous factors which the tester has no control over. Several examples are:

a. Combustion of mixed fuels.

b. Use of specially treated fuels which have atypical carbon-to-hydrogen ratios.

c. Oxygen or carbon dioxide enrichment of either the combustion or flue gases.

d. Control equipment prior to the test location which preferentially removes either oxygen or carbon dioxide from the flue gases.

Response: See Responses 3.3, 4.6, and 7.3.

Commenter IV-D-12

12.1 Comment: Verification that the fuel factor, F_o, is within $\pm$5 percent of the listed value or that calculated from ultimate analyses of fuel samples poses a significant problem for combination fuel boilers, especially those common in the pulp and paper industry. Determination of F_o for a boiler burning wood fuel and fossil fuel (oil, gas, or coal) would require extremely accurate monitoring of respective fuel flows. This is not practical, especially for the wood and coal fuel components.

Response: See Response 8.1.

12.2 Comment: We expect that the quality assurance intent can be achieved by following the proposal for checking the Orsat analyzer with ambient air at the completion of each test series to ensure the measured O_2 value is 20.9 $\pm$ 0.3 percent.

Response: No response is necessary.

12.3 Comment: Although this method revision is for combustion sources, we have a concern that it could be applied to lime kiln sources. Because of high CO_2 release rates in the calcining process, calculation of F_o factors will not be within ±5 percent of the listed values.

Response: See Responses 5.4 and 6.1.

Commenter IV-D-13

13.1 Comment: We are attempting to obtain actual field test data from several member companies in order to ensure that the proposed regulations are compatible with the actual performance of Methods 3, 4, and 5. Due to the long lead time required in collecting data, we have not been able to obtain and analyze significant amounts of data. We, therefore, request you to grant an additional comment period of 30 days to enable the completion of the data gathering and analysis effort presently underway.

Response: The Agency feels that there are sufficient data to make the changes to the promulgated version that have been made. No extension of the comment period is necessary.

13.2 Comment: It should be clearly stated that the procedures outlined in Section 4.4.1 are applicable only to those sources which have their emission standards written as ng/J or lbs/10^6 Btu. Section 4.4.1 cannot be applied when the emission standard is specified either as g/SDCM (kraft recovery furnace, lime kiln) or as g/kg feed (smelt dissolving tank vent).

Response: The procedure is applicable for organic and fossil fuel combustion sources and require Orsat measurement for O_2 correction or excess air determination. The form of the emission standard does not really matter.

13.3 Comment: Section 4.4.1 specifies that the fuel factor, F_o, should be within ± 5 of the established value. We assume that this was intended to be ± 5 percent.

Response: This is correct.

13.4 Comment: It has not been explained as to how the values of F_o presented in Section 4.4.1 were derived. A review of Method 19, Appendix A of 40 CFR Part 60 provides a possible means of calculating F_o by equating the emission estimates using the oxygen-based F_d factor with the emission estimates using the carbon dioxide based F_c factor.

When the values of F_d and F_c tabulated in Method 19 are used, the following values of F_o are obtained. It is suspected that the proposed values of F_o are in error.

Fuel Type	F_o, Proposed	F_o, Calculated
Coal		
Anthracite	1.070	1.072
Bituminous	1.140	1.136
Lignite	1.076	1.079
Oil	1.346	1.353
Gas		
Natural	1.749	1.750
Propane	1.510	1.530
Butane	1.479	1.456
Wood	1.050	1.055
Wood bark	1.056	1.085

Response: The calculation of F_o from F_d and F_c values is included in the promulgated version and is true for a specific fuel analysis. The numbers proposed represent midpoint values of many analyses. The wood bark value for F_c in Method 19 is incorrect and has been corrected in the promulgated revisions.

13.5 Comment: The procedure for calculating F_o for combination fuels has not been specified, and should be clearly outlined.

Response: See Response 8.1.

13.6 Comment: There are very limited data on the accuracy of Orsat O_2 and CO_2 measurements. According to Reference 4 cited in reference Method 3, the use of Orsat data "to convert particulate catches to such reference conditions as 12 percent CO_2 and 50 percent excess air may introduce sizeable errors in the corrected particulate loading." We suggest that any Method 3 quality assurance requirement should take into consideration any published Orsat performance data and any data generated by EPA quality assurance audits for Orsat analyses for O_2 and CO_2.

Response: The criteria in the proposal represent what can be achieved with good sampling and analysis techniques. Data in QA audit reports include errors through testers' mistakes and miscalculations. These factors should be eliminated by a good quality control program.

13.7 Comment: The concept of a fixed error limit (5 percent) to the estimated value of F_o imposes varying limits of accuracy on O_2 and CO_2 measurements as a function of excess air. This can be illustrated by the following example. Consider a source utilizing a fuel with a theoretical F_o of 1.093.

At very low excess air (4 percent O_2), an absolute error of 0.41 percent is allowed in the measurement of O_2 and CO_2 to stay within 5 percent of theoretical F_o. However, if the excess air increased to a high level (15 percent O_2), the allowed absolute error would be reduced to 0.14 percent.

The objective of a QA step in Method 3 should be to achieve best O_2 and CO_2 data and not to specify method performance based upon source operating conditions, since these are unrelated. It is thus obvious that the use of F_o as a quality assurance check on Method 3 is not valid and should be reconsidered.

Response: The objective of a quality control procedure is to provide the means to indicate that the measured data are acceptably accurate. It is true that greater accuracy in the Orsat results is required to meet the F_o check at higher excess air, but better accuracy is desired under these conditions because O_2-corrected emission rates are more sensitive to Orsat errors at high excess air than at low excess air.

13.8 Comment: Based upon the limited data provided to NCASI by member mills, F_o values for bark boilers and combination wood waste-fossil fuel boilers are substantially different from theoretical values. These differences may be from nonuniform F_o factors for bark and wood samples derived from different species, and inability to accurately estimate heat input rate from bark and wood waste. It is

common to estimate heat input rate from bark by making daily bark consumption estimates and using an average bark Btu content.

It is, therefore, recommended that the proposed QA procedure should not be applied to wood waste and combination boilers.

Response: See Response 8.1.

Commenter IV-D-14

14.1 Comment: Orsat equipment is a familiar technology that has been in use for many years. The audit of the Orsat equipment appears reasonable; in fact, the procedures outlined in the proposed rules are part of standard operating procedure for many of our members. However, newer technologies than Orsat equipment, specifically electronic flue gas analyzers, offer greater ease of measurement and greater accuracy. Electronic flue gas analyzers may well prove to be less expensive to use than Orsat equipment over the long run, with substantially improved accuracy, and precision. American Public Power Association (APPA) therefore, recommends that EPA allow the use of approved electronic flue gas analyzers at the discretion of the owner as an alternative to Orsat equipment.

Response: The scope of these revisions does not include O_2 meters. Alternative procedures can be submitted to the Agency for review provided comparison data between the alternative and the reference method are included as well as a detailed procedure description of the alternative.

14.2 Comment: The second concern relates to the requirement that all testing and calibration be performed in the field. Conditions for accurate analytic results may be best served by allowing calibrations to be run at ground level under laboratory conditions. Recalibration using "ambient" air up in the stack may not be accurate because O_2 levels may be skewed by the presence of higher carbon monoxide and carbon dioxide levels, as well as perhaps other gaseous components. Thus, the audit of the Orsat equipment using stack "ambient" air may not be completely accurate. APPA, therefore, recommends that multiple sampling runs be allowed with the check for Orsat equipment accuracy on ambient O_2 levels to be run at ground level under laboratory conditions. Should EPA be able to verify that there is no difference in "ambient" O_2 levels drawn from the stack or at ground level, APPA withdraws this recommendation.

Response: The Agency feels that ambient air O_2 values will be within narrow limits at any outdoor or well-ventilated location. However, the ambient air check of the Orsat analyzer is no longer a requirement of the method, only a recommendation.

14.3 Comment: In the Federal Register (FR 47:39204-39205, September 7, 1982) listing for these proposed regulations at the bottom of page 39205, it is proposed that the owner "verify that the fuel factor, F_o, is within ± 5 of the established value" of the F_o values

shown in the accompanying table. This value appears to be a typographical error. APPA assumes the correct value would be ±5 percent of the F_o values shown in the table. APPA recommends this value be clarified in the final rules.

Response: See Response 3.1 and 13.3.

Commenter: IV-D-15

15.1 Comment: This division agrees that this is an excellent quality assurance tool. However, this division comments that if the quality assurance procedures outlined in Section 4.4 and the accuracy requirements set forth in Method 3 can be met by a procedure other than sample collection in a bag and analysis by an Orsat that this procedure could be utilized as an alternate to Method 3. Specifically this division considers that the continuous collection of gas samples at each point of the particulate traverse and the continuous analysis of these samples for oxygen, carbon dioxide, and carbon monoxide with electronic analyzers utilizing a weighted average of the results obtained to determine the F factor for heat input would be an acceptable alternate to Method 3. This assumes that the quality assurance procedures stated in Section 4.4 are met, the accuracy requirements of Method 3 are met, acceptable calibration procedures for the instruments are implemented, and that documentation of the calibration of the instruments both prior to and after the collection of the sample is presented in the test report.

Response: See Response 14.1.

Commenter IV-D-16

16.1 Comment: The proposal gives no hard data in support of revision. The only justification for imposing this additional analytical burden is a brief reference in the summary section of the proposal which states that "(t)he current regulation includes only limited quality assurance requirements and, as a result of this proposed regulation, the quality of compliance data will improve." Such an unsupported statement is inadequate as the basis for revising any rule, but especially one as well established as Method 3. Furthermore, we do not agree with it and believe that existing quality assurance procedures under Section 4 of Method 3 are sufficient.

We would urge EPA to withdraw this proposal pending the presentation of hard supporting data and the opportunity for public review and comment concerning the supporting data base. Moreover, we would strongly recommend that field data, rather than laboratory data, be used to support any changes.

Response: The Agency has received a mandate to provide quality assurance and quality control procedures to the test methods in an effort to assess and assure data accuracy and precision for all compliance tests. The Agency feels the quality control procedures in the promulgated revisions are adequately supported and are achievable.

16.2 Comment: The proposed language under Section 4.4.1 calls for verification" . . . that the fuel factor, F_o, is ± 5 of the established

value . . ." EPA has advised us that this should have read "±5 percent," however, and that is the meaning upon which the following discussion is premised.

EPA proposes to require that field determinations of F_o agree within ±5 percent of the established value before a test run can be accepted. This seems an unworkable standard with respect to the combination fuel boilers so prevalent in the pulp and paper industry. We do not believe combination fuel boilers can meet the ±5 percent F_o criterion because of inherent difficulties in the accurate measurement and precise control of fuel feed rates, and the variability in fuel quality, especially when burning wood and bark. With respect to variability in fuel quality, for example, the moisture content of bark can vary from less than 40 percent to more than 70 percent, and the BTU content of natural gas can vary by ±5 percent.

Our data are too limited at this point to conclusively establish how much the ±5 percent F_o criterion would have to be relaxed to become reasonably attainable for combination fuel boilers. It does strongly suggest, however, that the criterion would have to be increased to at least ±10 percent F_o to be reasonable. The very best solution is probably to exempt all combination fuel boilers from meeting the F_o test, should one be imposed, and we recommend this course of action should this proposal become effective.

Response: See Responses 8.1 and 3.1.

16.3 Comment: The proposed revision does not speak to how the "established" F_o should be calculated for combination fuel boilers burning more than one fuel at a given time. We recommend that EPA clarify the exact procedure for dealing with the calculation of the "established" F_o for combination boilers should such boilers ultimately fall under these requirements.

Response: See Response 8.1.

16.4 Comment: The "established" F_o fuel factors listed in the table under proposed Section 4.4.1 are not in good agreement with the F_o fuel factors we have calculated from the fundamental values of F_d and F_c given in §60.45(f)(4). We recommend that EPA recheck these "established" F_o values.

Response: See Response 13.4.

16.5 Comment: Finally, with respect to the F_o test, the proposal does not make it clear that this criterion is inappropriate for sources, such as kraft pulp mill recovery boilers, which have flue gas concentration-based emission standards. In these instances, and for good causes, there are not "established" F, F_c or F_o fuel factors. For example, the black liquor fired as fuel in a recovery boiler is very variable in composition and fuel value, and cannot be characterized with single valued fuel factors. We urge EPA to exempt from the F_o test any source which has emission standards cast as flue gas concentrations.

Response: See Response 9.3 and 13.2.

Commenter IV-D-17

17.1 Comment: Instead of merely assuring agreement of Orsat results within ±5 percent of established F_o factors, a fuel analysis of the fuel to be utilized should be obtained prior to testing and Orsat results compared with a theoretical combustion analysis of the fuel. The Orsat results should be within ±5 percent of the theoretical O_2 and CO_2 determined from the fuel analysis as well as the established F_o factor. Comparison of Orsat results with the theoretical analysis is easier and more specific for a given fuel than in comparison with the F_o factor.

Response: The commenter's approach is often impractical for many types of fuels as obtaining a representative sample is very difficult or methods do not exist. The procedure is flexible enough to allow comparisons with the F_o table of ranges in almost all cases. See also Response 7.5.

17.2 Comment: Instead of merely checking the Orsat with ambient air, it would be better to check it with a calibration gas of similar composition to that being tested (CO_2 and O_2 in N_2). By merely checking the Orsat with ambient air, the CO_2 absorption chemical is not checked. This procedure is more tedious and expensive than checking the Orsat with ambient air.

Response: See Response 7.6.

17.3 Comment: In Section 4.4.1, page 39205, the following statement is made, "Using the following procedures verify that the

fuel factor, F_o, is within ± 5 of the established value . . .". My question is - is the number ± 5, ± 0.5 or ± 5 percent?

Response: See Response 13.3

17.4 Comment: The value of F_o for oil is given in the table to be 1.345. Our calculations indicate that this value is only true for light oil. If so, what about residual oil?

Response: The promulgated revisions include a table with a range of acceptable F_o values. The range for oil should include most oils used as fuel.

TABLE 1. List of Commenters

Document Number	Commenter
IV-D-1	From R.A. Reckart, Vice President Fossil and Hydro Production, Northeast Utilities to Docket Number A-82-05. Subject: Comments on proposal of revisions to Methods 3, 4, and 5.
IV-D-2	From C.D. Malloch, Regulatory Management Director, Air, Environmental Policy Staff, Monsanto Co. to Docket Number A-82-05. Subject: Comments on proposal of revisions to Method 3.
IV-D-3	From Robert E. Wooten, Jr., Source Test Engineer, North Carolina Department of Natural Resources and Community Development to Docket Number A-82-05. Subject: Comments on proposal of revisions to Method 3.
IV-D-4	From Jerry W. Powell, Environmental Programs Chemist, Texasgulf Chemicals Company to Docket Number A-82-04 (moved to A-83-05). Subject: Comments on proposed revisions to Method 3.
IV-D-5	From Richard H. Russell, Supervisor, Environmental Testing, Owens-Illinois, Inc. to Docket Number A-82-05. Subject: Comments on proposed revisions to Methods 3, 4, and 5.
IV-D-6	From Dale S. Harmon, Sr. Environmental Engineer, Texas Industries, Inc. to Docket Number A-82-05. Subject: Comments on proposed revisions to Method 3.

TABLE 1. List of Commenters

(Continued)

Document Number	Commenter
IV-D-7	From Randall J. Richert, Environmental Scientist, Southwestern Laboratories, Inc. to Docket Number A-82-05. Subject: Comments on proposed revisions to Methods 3, 4, and 5.
IV-D-8	From James E. Walther, Supervisor, Air and Noise Programs, Crown Zellerback to Docket Number A-82-05. Subject: Comments on proposed revisions to Methods 3, 4, and 5.
IV-D-9	From Bill J. Mullins, Jr., President, Mullins Environmental Testing Company, Inc. to Docket Number A-82-05. Subject: Comments on proposed revisions to Methods 3 and 5.
IV-D-10	From Perry Lonnes, President, Interpoll, Inc. to Docket Number A-82-05. Subject: Comments on proposed revisions to Method 3.
IV-D-11	From Bruce G. Hawks, Supervisor Quality Assurance Source Sampling Division., Entropy Environmentalists to Docket Number A-82-05. Subject: Comments on proposed revisions to Method 3.
IV-D-12	From Danny B. Sjolseth, Section Manager, Air Technology Research and Development to Docket Number A-82-05. Subject: Comments on proposed revisions to Methods 3, 4, and 5.

TABLE 1. List of Commenters

(Continued)

Document Number	Commenter
IV-D-13	From Ashok Jain, Engineering Projects Research Manager, National Council for Air and Stream Improvement, Inc. to Docket Number A-82-05. Subject: Comments on proposed revisions to Methods 3, 4, and 5.
IV-D-14	From Michael K. Bergman, Staff Scientist, American Public Power Association to Docket Number A-82-05. Subject: Comments on proposed revisions to Method 3.
IV-D-15	From Harold E. Hodges, Director, Tennessee Air Pollution Control Division, Tennessee Department of Public Health to Docket Number A-82-05. Subject: Comments on proposed revisions to Methods 3, 4, and 5.
IV-D-16	From S.L. Estes, Specialist, Air and Water Resources, Union Camp Corp. to Roger Shigehara. Subject: Comments on proposed revisions to Methods 3, 4, and 5.
IV-D-17	From W.H. Axtman, Executive Director, American Boiler Manufacturers Association to Roger Shigehara. Subject: Comments on proposed revisions to Methods 3, 4, 5, and 7A.

TECHNICAL REPORT DATA
(Please read Instructions on the reverse before completing)

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15. SUPPLEMENTARY NOTES

16. ABSTRACT

This document addresses the public comments submitted after proposal of the revisions to Method 3 in the Federal Register. Changes made as the result of these comments are included. This document serves as a basis for the changes made in the revisions to Method 3 between proposal and promulgation.

17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTORS	b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group

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